

overwhelmed, even when their lamps were burning freely. These facts point to an entirely different mode of treating those who have been rescued and who are still suffering from the effects of after-damp, from that which has been hitherto adopted. It is not too much to say that many a life could have been saved if, acting on Hoppe-Seyler's observations, artificial respiration could have been maintained for some time after apparent death.

There is much in this book that we should have liked to have dwelt upon had space permitted, for almost on every page we discern evidences of originality and freshness such as might be expected from one who, as we have seen, has brought the researching spirit to bear upon his subject. Whilst chemists are wearying themselves and others with vain speculations as to bonds and atomic-groupings, far too many of the common matters of everyday life are thrown aside as unfruitful or worked out. No one, however, could take up this book and not see that in the matter upon which it treats there are fifty problems waiting for solution—some of them most pressing in the interests of humanity, and any one of them capable of yielding a rich harvest of facts. T. E. THORPE

### THE MORPHOLOGY OF THE ECHINODERMS

*Morphologische Studien an Echinodermen.* Von Dr. Phil. Hubert Ludwig, Director der naturwissenschaftlichen Sammlungen in Bremen. 1 Band mit 23 Tafeln und 5 Holzschnitten. (Leipzig: Verlag von Wilhelm Engelmann, 1877-79.)

WITHIN the last three years very numerous researches have been made on that most interesting group, the Echinoderms, to which, we are glad to see, the rank of a distinct sub-kingdom is now generally assigned. Greeff, Götte, Lange, Ludwig, Simroth, and Teuscher, in Germany; Perrier in France, Théel and Lovén in Sweden, Agassiz, Lyman, and Pourtalès in America; and in our own country Sir Wyville Thomson, Duncan, Sladen, and the two Carpenters, father and son, have each contributed more or less to our knowledge of the morphology and physiology of the group.

Of the many observations made and recorded by the above-mentioned naturalists, those of Dr. Ludwig ("Ei-bildung Ludwig," as we have heard him called by embryologists) seem to us to be among the most important, alike from their variety, and, as we are strongly inclined to believe, from their general accuracy. We are not so sure, however, that all Dr. Ludwig's conclusions are as correct and reliable as his observations are trustworthy, for there are certain points on which we have very strong grounds for dissenting from his views.

The volume before us, representing the result of three years' work, mostly microscopic, is the first of a promised series of studies in Echinoderm morphology, and consists principally of memoirs on the anatomy of Crinoids and Starfishes.

It contains much that is new, or rather that was so when the individual memoirs were first published in the *Zeitschrift für wissenschaftliche Zoologie*, and much that is to be found, stated more or less correctly in the writings of other workers, both before Ludwig and contemporaneous with him.

The first paper in the series, forming about one-third

of the whole volume, is devoted to the anatomy of Comatula. While generally confirming Dr. Carpenter's results, respecting the canals of the arms and the chambered organ, Ludwig (whose observations on this type were contemporaneous with those of four other observers, two in Germany and two in this country) publishes several new and interesting anatomical details.

Among the most important of these is the presence of blood-spaces around the genital organs, and also of a system of blood-canals ventral to the water-vascular system. Both of these systems probably communicate with the vascular "axial prolongation" of Dr. Carpenter, which runs up into the disc from the chambered organ situated in the calyx, and represents the "heart" of the Starfishes.

Ventral to the radial blood-canal is the fibrillar sub-epithelial band, to which Dr. Ludwig assigns a nervous character from its resemblance to a similar and similarly placed structure, that is generally, though not universally, supposed to be the nerve of the arm of a Starfish.

Ludwig's views have been completely adopted by Gegenbaur, in spite of the fact that this band is absent from half, or sometimes from more than half, the arms of many Comatulæ. We scarcely think that Ludwig has taken this fact sufficiently into consideration in his discussion of Dr. Carpenter's suggestion that the axial cords of the skeleton constitute the chief nervous system of Comatula; and we are not altogether satisfied with the purely diagrammatic manner in which he figures this axial cord, and with the meagre description which he gives of it. He makes no mention whatever of the regular manner in which it gives off branching bundles of fibres to the muscles and other structures in the middle of every arm-joint, except [in quoting their discovery by others, though he cannot well have helped seeing them, and he does not deny their existence. At the same time he seems inclined to admit the probative force of Dr. Carpenter's experiments at Naples, which tend to show that these axial cords are the *motor* nerves, at any rate of the complex Crinoid organisation, permeated though they may be by a coagulable fluid. Should this view be the true one, it is another argument in favour of Leuckart's separation of the Crinoids and their allies from the other Echinoderms, to form a distinct class, the *Pelmatozoa*.

Until lately the Crinoids have not been credited with an ambulacral system homologous with that of the other Echinoderms. Götte, however, has shown that, as far as development is concerned, this is not the case, and the true water-vascular ring of the adult Comatula was first described by Ludwig, though its radial branches in the arms have long been known. Depending from it into the coelom are numerous small tubules which Ludwig describes as open at the ends, and compares to the sand-canals of the other Echinoderms, more especially of the *Holothurians*.

After finishing his researches on the anatomy of Comatula, Ludwig turned his attention to Rhizocrinus, and found that it corresponds with Comatula in all essential points of structure. This was the first-stalked Crinoid in which the presence of a chambered organ was determined. It has since been found in *Pentacrinus* and *Bathycrinus*, and Ludwig's discovery that its chambers are continued down the axis of the stem as five blood

canals disposed around a central axis, has received abundant confirmation.

The curious genus *Rhopaladina* has been supposed by some writers to be the type of a new group of Echinoderms, with mouth, anus, and genital opening at the centre of one of the poles of the body. Ludwig shows, however, that it is merely an aberrant Holothurian, much bent on itself, owing to the almost complete disappearance of the medio-dorsal inter-radius, an exaggeration, in fact, of a condition very commonly met with in *Cucumaria*. Ludwig's memoirs on the Asterids contain several novelties, two of the most important of which are as follows:—

1. The pores in the madreporic plate have no communication with the cœlom, but lead solely into the sand canal. The same fact has been noted by Perrier for the Echini, and it is the more singular because the body cavity of the Crinoids is in free communication with the exterior.

2. The genital glands do not discharge their products into the body cavity, but are provided with longer or shorter ducts that open directly on the exterior of the body. Around the glands are blood spaces, just as in the Crinoids, and these are connected with a very complicated blood-vascular system, which Dr. Ludwig describes exceedingly well, clearing up many points which had hitherto been very obscure and scarcely understood. This is especially the case with the remarkable genus *Brisinga*, which Sars supposed to be without a blood-vascular system. Ludwig contributes many valuable observations to the anatomy of this type, and shows that in all essential features it is a true Asterid, though he does not share Sars' views of its relationship to Protaster.

The volume closes with a striking paper on the Ophiurids, in which it is shown that the whole of the oral skeleton of the disc is the result of modifications of the first two arm-vertebræ and of the adambulacral and superambulacral plates corresponding to them. But the chief novelty in this paper relates to the genital clefts. These have been hitherto supposed not only to let the genital products pass out of the cœlom, but also to admit water into it. Ludwig shows, however, just as in the case of the Asterids, that both these hypotheses are incorrect. The sexual products are not discharged into the cœlom, nor does water enter it by the clefts, but the latter open into pouches or bursæ which are merely involutions of the general integument of the body, and receive the short ducts of the genital glands, probably serving also as a respiratory apparatus. Their inner surface, that turned towards the cœlom, is curiously folded, and their whole structure is so very similar to that of the hydrospires of the Blastoidea that Ludwig is led to suggest a homology between these two sets of similarly placed organs. Billings considered the hydrospires to be respiratory in function, and found them to be connected with the "spiracles" or genital openings, which would thus be homologous with the genital, or, as Ludwig prefers to call them, "bursal" clefts of the Ophiurids.

Should further investigation confirm this interesting discovery of Ludwig's, and the conclusions he has drawn from it, we quite agree with him in regarding it as one of great importance respecting the relations of the various echinoderms *inter se*.

We shall look with great interest for the publication of Dr. Ludwig's promised researches on the Echini and Holothurians at, we trust, no distant time; and also for his concluding work on the comparative morphology of the sub-kingdom as a whole, which will not, we imagine, be altogether a pillar of strength to Hæckel's celebrated "Worm Theory of the Echinoderms."

#### OUR BOOK SHELF

*Jornal de Sciencias Mathematicas Physicas e Naturaes.* Publicado sob os auspícios da Academia Real das Sciencias de Lisboa. No. xxiii. agosto de 1878. (Lisboa, 1878.)

*Giornale di Matematiche: ad uso degli Studenti delle Università Italiane.* Pubblicato per cura del Professore G. Battaglini. Vol. xvi. (Napoli, 1878.)

WE have not seen any previous numbers of the first of these publications, but from the specimen before us we should certainly conclude that this Society is doing good work. In fifty-two octavo pages we have specimens of work in all the lines indicated in the above title. The opening paper, by C. A. Moraes de Almeida, is an "estudo geral dos espelhos curvos" (continuation, 11. pages); Chapter IV. treats of spherical, elliptical, and parabolical mirrors of very small aperture; Chapter V. discusses some cases of practical difficulty in the formation of images. The second paper is a mathematical one by L. F. Marrecos Ferreira; 1st part, on the geometrical properties of the intersections of right cones, derived from the principle of the homological transformation; 2nd part, on the properties of conics tangential to the sides of an angle and their application to the study of surfaces (18 pages). Both papers are neat, and contain interesting properties.

Zoology follows, with two contributions by J. V. Barboza du Bocage, first with a list (the sixteenth) of the birds in the Portuguese possessions in West Africa (15 pages), next under the title "Mélanges Ornithologiques," remarks on new species of Angola (*Nectarinia anchieta*<sup>1</sup>) and on individual birds of the families Certhiidae (*Hylopsornis Salvadori*), Paridae (*Parus rufiventris*), Laniidae (*Lanius Souzae*, *Nilaus affinis*).

The last two pages contain a slight account of 111 plants, collected in Caconda by Signor Anchieta. Remarks are made on the points of contact between some of the plants in this collection and that got together by the late Dr. Welwitsch.

The second journal maintains its reputation for its contributions to the study of geometry. Where there is so much to praise we must limit ourselves to giving here the bare titles of some of the longer papers:—Ricerche geometriche sopra alcune proprietà dei sistemi di rette nel piano e dei sistemi di circoli che passano per un punto sul piano e sulla sfera, per T. Fuortes (56 pp.); Sulla riforma dell'insegnamento geometrico, nota di G. Fiedler seguita da tre lettere inedite dell'autore (13 pp.); Sull'infinità circolare non Euclidea, per G. Battaglini (7 pp.); Relazione fra l'area e il perimetro, fra il volume e la superficie, fra i momenti, fra le coordinate dei centri di gravità per gli spazi limitati da linee e superficie che hanno l'equidistante della stessa natura per U. Dainelli (20 pp.); Sulla teoria delle quadriche omofocali del punto di vista sintetico per F. Maglioli (36 pp.); Nozioni preliminari per la geometria proiettiva dello spazio rigato, Nota di F. Aschieri (19 pp.); Sopra le curve piane del 3° ordine con un punto doppio, per P. Anelli (14 pp.).

*The History of Coal.* By the Rev. T. Wiltshire, M.A. F.G.S., &c. (E. and F. N. Spon, Charing Cross and New York. Pp. 36, 1878.)

THIS pamphlet is the introductory lecture which the

<sup>1</sup> So named from the finder, who met with a single specimen, October, 1877, in the interior of Benguela.